i-meter®45 Specification and User Guide

intellimeter
CANADA INC.

Innovative Metering Solutions

i-meter®45

CONTENTS

1. Product Description

The i-meter®45 is a next generation multi-customer metering system (MCMS) product based on MP-636 series of meters, by Intellimeter Canada Inc. (ICI). It is installed directly inside an electric panel.

The i-meter®45 represents a new level of functionality in revenue grade electricity meters. It has 45 current inputs, 3 voltage inputs, and up to a total of 45 separate meters.

Fig. 1-1 i-meter®45 meter

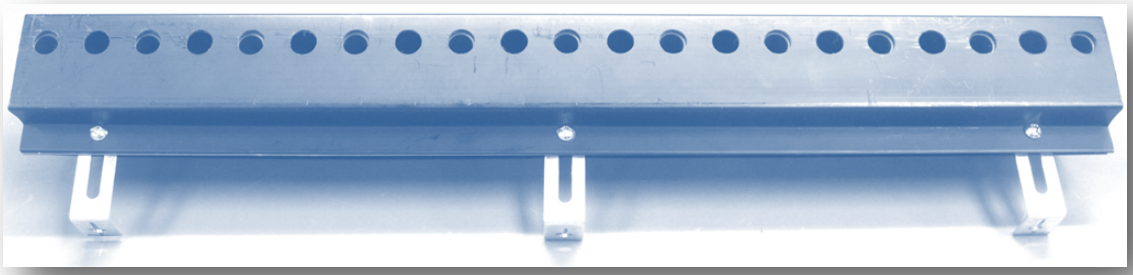


Fig. 1-2 i-meter®45 21_CT board

Fig. 1-3 i-meter®45 Smart Display – MDU

1.1. General Information

The i-meter®45 is similar to the i-meter®636 meter in physical construction and in its measurement principles. The i-meter®45 also provides an extended range of software configurable features, alphanumeric display and power quality monitoring.

The i-meter®45 has a wide range solid-state switching type power supply. The meter is powered from Line1 and Neutral. The standard voltage range is 120V to 347V (60/50Hz), the operation low voltage range is 69 to 380V.

1.2. Specification

a. Voltage Range: Auto range 120-347VAC (L-N), -20% to +10% of rating
b. Rated VA: <12VA
c. Current Range: CTs Primary 0 – 600A, CTs Secondary 0 – 0.1A
d. Accuracy Class: 1.0
e. Meter constant (K_h): 1Wh, 1VAh or 10Wh, 10VAh or 100Wh, 100VAh
f. Measurements:
    - Total Energy: kWh, kVAh are accumulated in non-volatile memory on the meter
    - Real Time Measurements: V (RMS) per phase, I (RMS) per phase, W per phase, VA per phase, power factor per phase, frequency
    - Power Quality: Per phase V & I Total harmonic Distortion (THD), Per phase V & I individual harmonic order up to 12^{th}
g. Service type: 1Φ2W, 1Φ3W, 2Φ3W, 3Φ4W (Programmable)
h. Digital Inputs/Outputs:
    - Up to 45 optical isolated pulse outputs
    - One optical isolated RS232C port for programming meter configuration
    - One optical isolate port for i-meter®45 Smart Display – MDU
    - One optical isolate port for communication module
i. Analog Inputs:
    - Up to 45 CT inputs (Max 100mA)
    - Three phase voltage reference inputs (V_{max} : 347VAC L-N)
j. Communication: Modbus RTU
k. Hardware version: 101-01282 BD. REV-DE
l. Firmware version: V1.0.4

2. Operation Instructions

2.1. i-meter®45 Wiring Guide

Fig. 2-2 is the i-meter®45 wiring diagram. The branch CTs connect to Port A, B, C, D using a ribbon cable.

- Port A: CT1 – CT12
- Port C: CT13 – CT21
- Port B: CT22 – CT33
- Port D: CT34 – CT42
- Main CTs L1: CT43
- Main CTs L2: CT44
- Main CTs L3: CT45
- Voltage Input: L1, L2, L3 and N
- DISP(optional): i-meter®45 Smart Display (MDU)

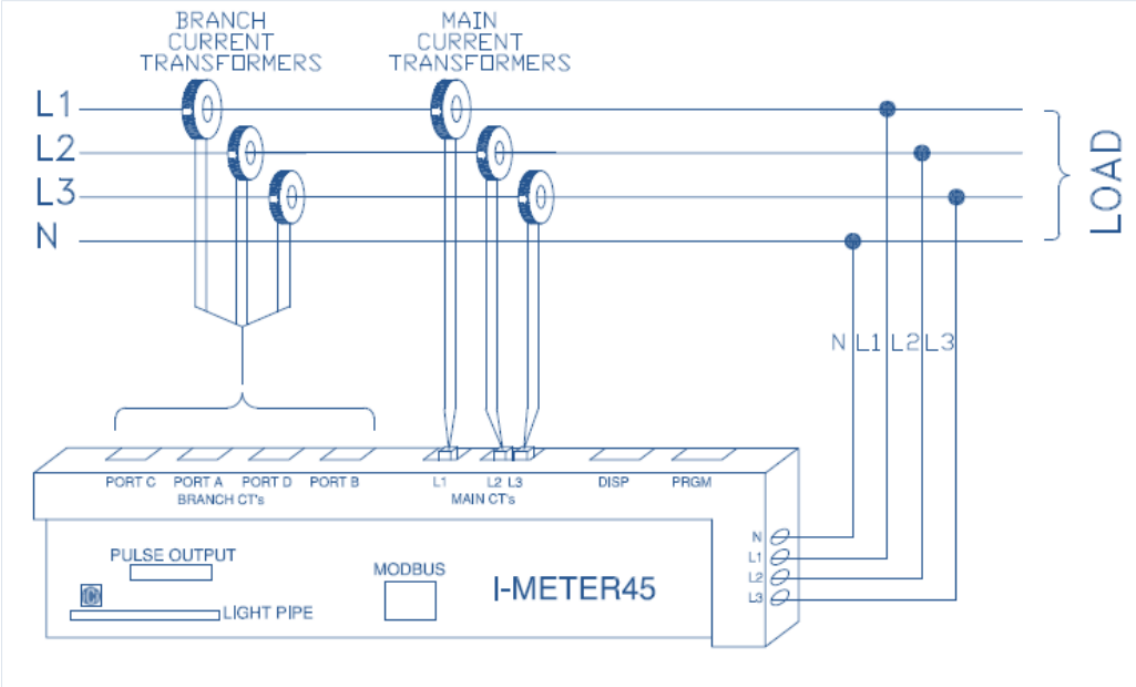


Fig. 2-2 i-meter®45 wiring diagram

Fig. 2-3a and Fig. 2-3b are typical applications using 21CT boards. The first wire of the ribbon cable (Red) must be plugged in Pin 1 of the i-meter®45 board and 21CT board. The main CT X1 must be connected to proper pins. Refer to Fig. 2-1.

Fig. 2-4 is a typical application using CT terminal boards. It allows you to use any type of CTs that have a maximum 0.1A (100mA) secondary current.

See Appendix 1 for connection of the optional pulse output board.

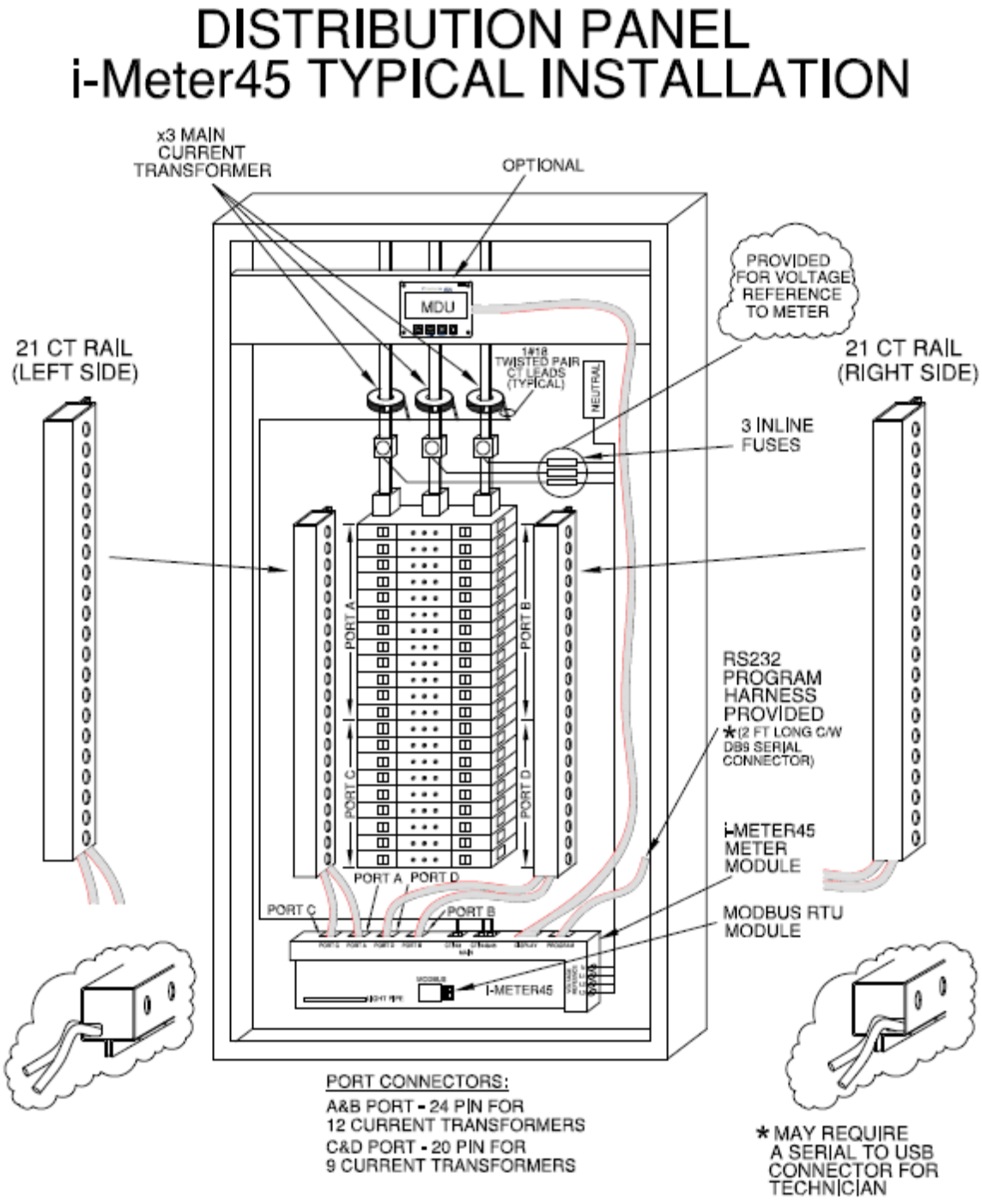


Fig. 2-3a Typical Application Using 21CT Boards

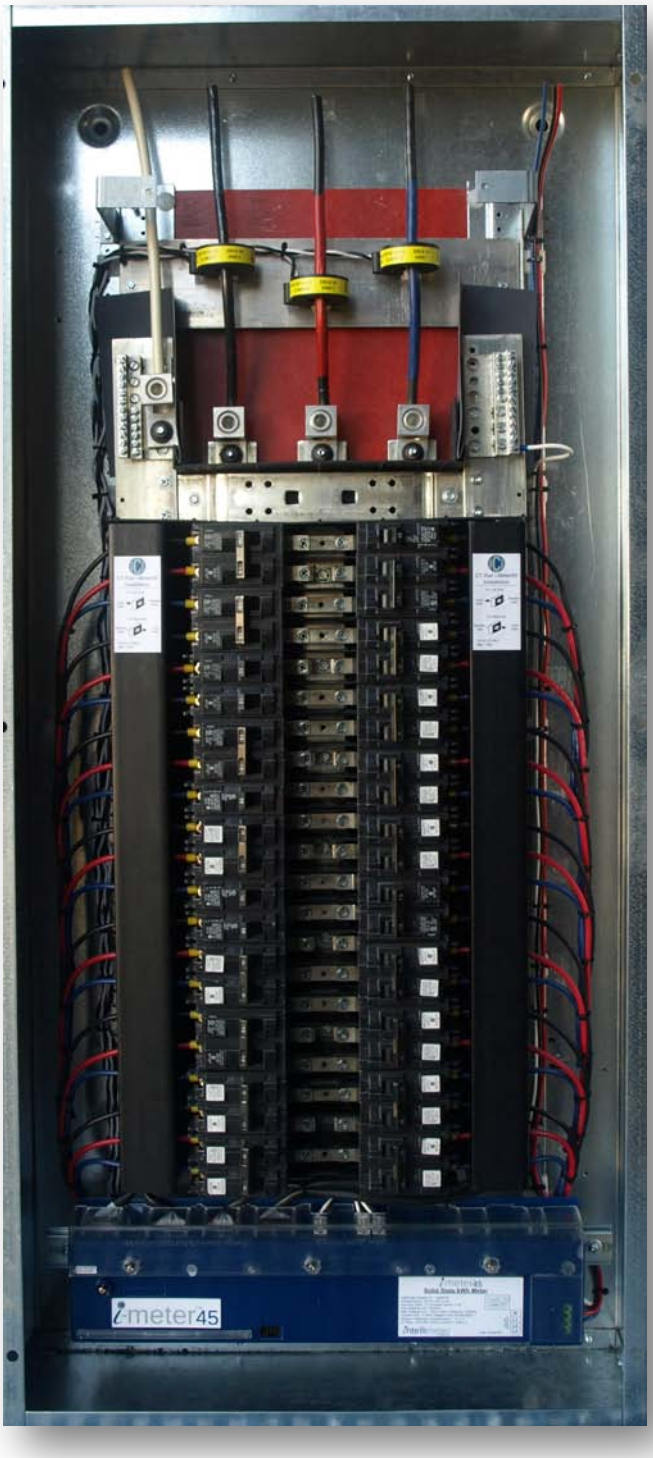


Fig. 2-3b Typical Application Using 21CT Boards

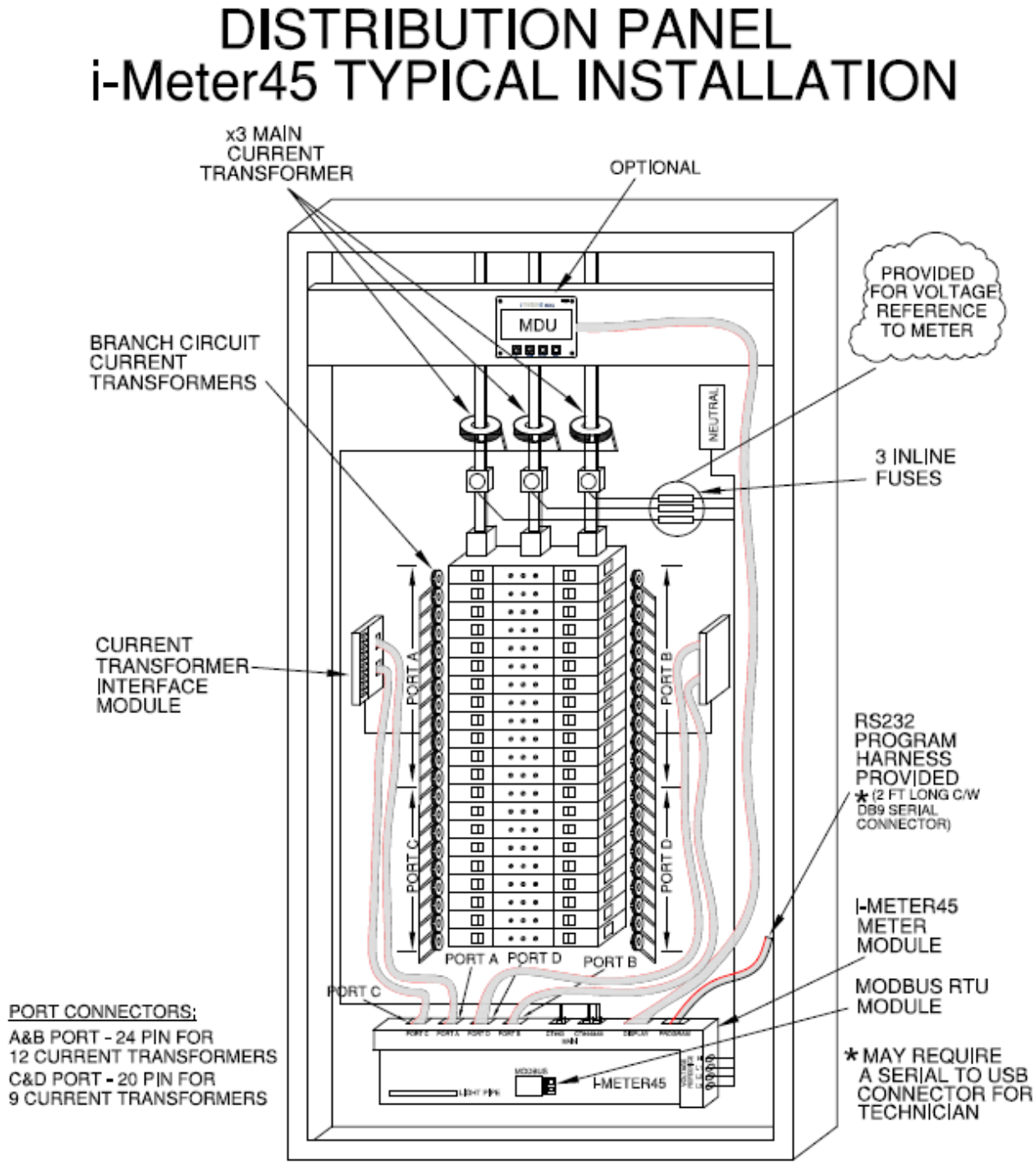


Fig. 2-4 Typical Application Using CT Terminal Boards

3. i-meter®45 MDU Display

3.1. i-meter®45 Smart Display – MDU

The Smart Display has a 20×4 character LCD. It is powered from the meter by an isolated DC/DC converter. The communication between the meter and Smart Display is an optical isolated RS232C port. The Smart Display (i-meter®45 MDU) displays customer information, real time measurements, total energy consumption, and power quality of each customer.

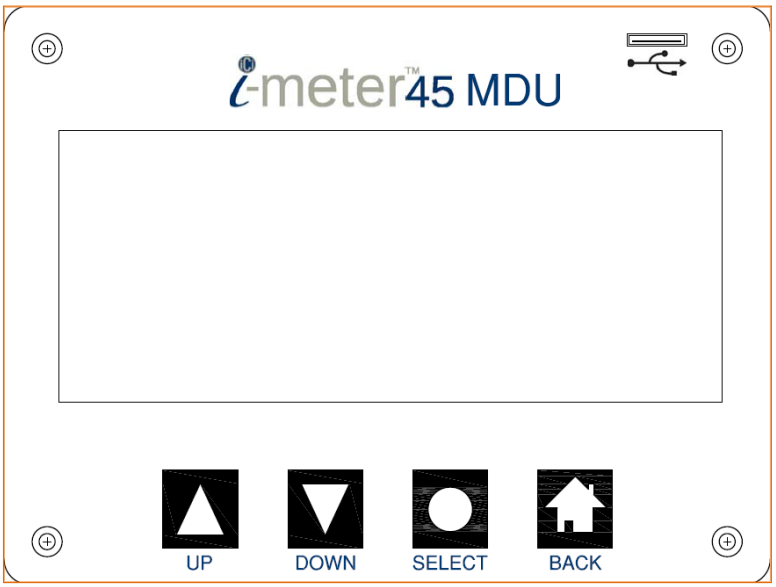


Fig. 3-1 i-meter®45 Smart Display

3.2. i-meter®45 Smart Display operation flow chart

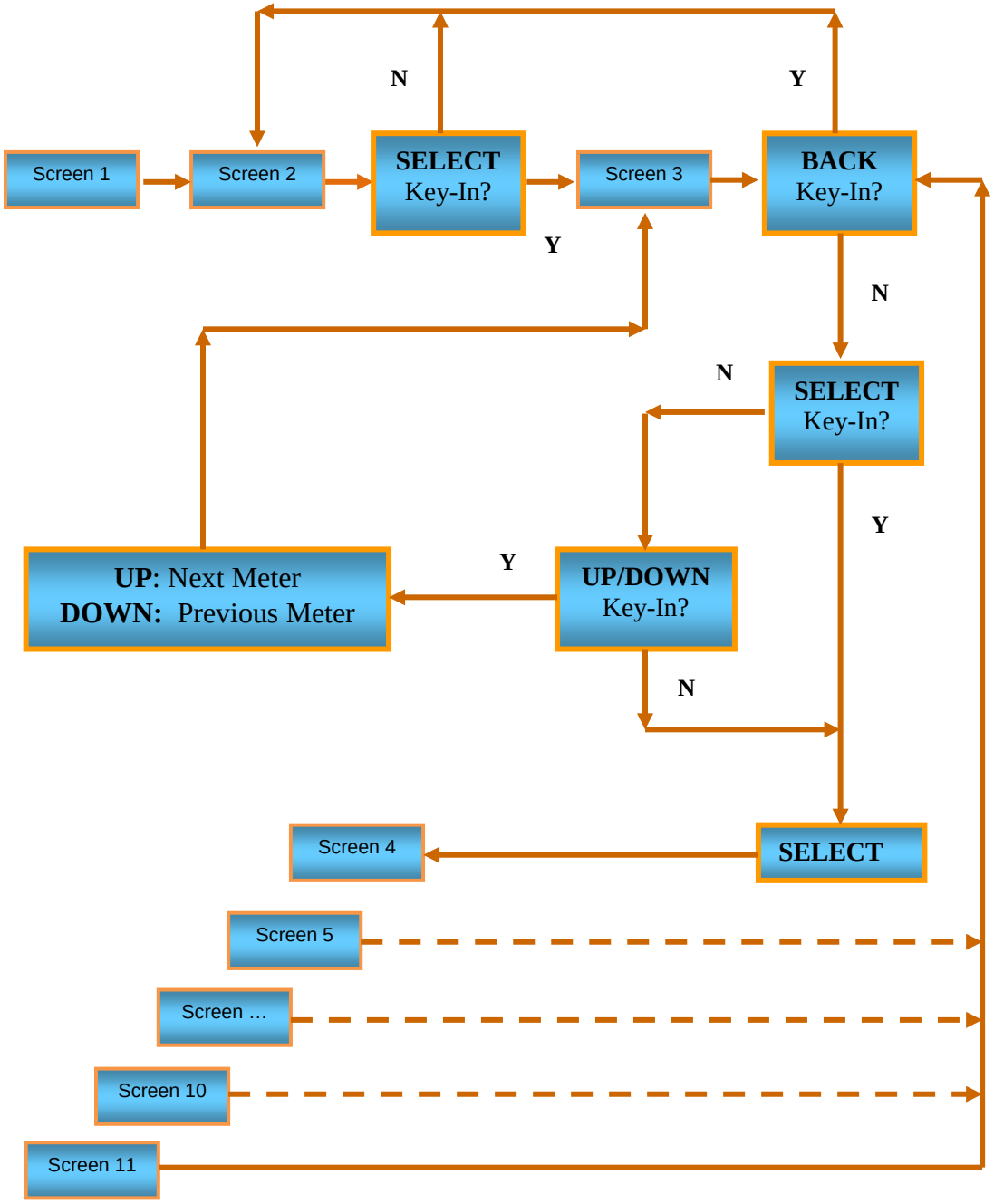


Fig. 3-2 i-meter®45 Smart Display Operation Chart

1.1. i-meter®45 Smart Display individual screens

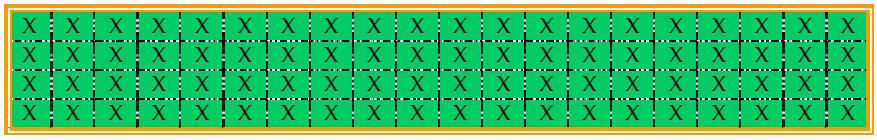


Fig. 3-3 Start Up Display Screen 1

In Fig. 3-3:

- Where the "X" shall display "1" for 2s, and then "2" for 2s, up to "9"

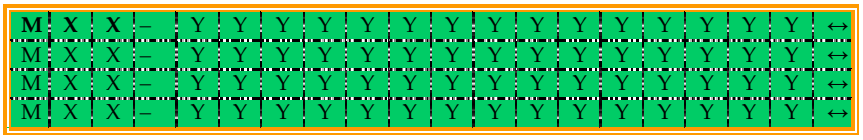


Fig. 3-4 Home- Screen 2

In Fig. 3-4:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The blinking "MXX" is default selected meter, which you are able to read all measurements by pressing "SELECT" button.
- Default auto scroll: the selected meter shall blink for 5 seconds and then next meter … etc.

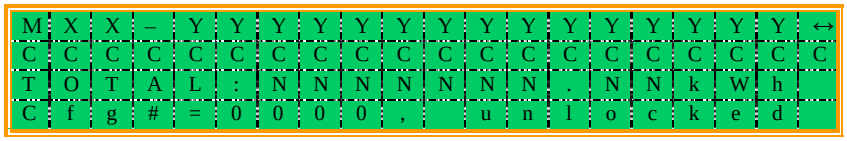


Fig. 3-5 Display Screen 3

In Fig. 3-5:

- Where the "X" is the meter number, the "Y" is customer ID, the "C" is customer Information.

- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "N" is number 0-9, total kWh.
- The "unlocked/locked" indicates the meter sealing status, see the sealing section (i-meter®45_Doc_XXX).
- The "Cfg#=0000" is reserved for manufacture use only.

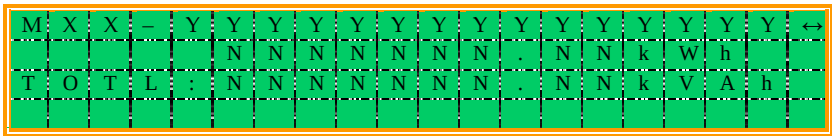


Fig. 3-6 Display Screen 4

In Fig. 3-6:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "N" is number 0-9, total kWh & kVAh.

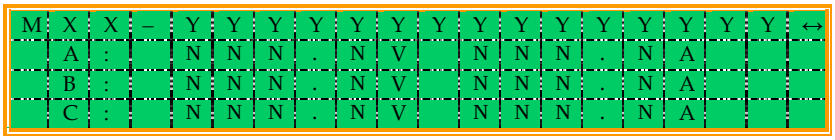


Fig. 3-7 Display Screen 5

In Fig. 3-7:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "A,B,C" represent A, B and C phase. The "N" is number 0-9, they are instantaneous voltages & currents of each phase.

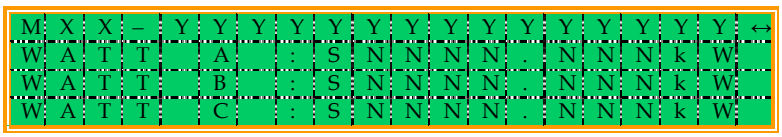


Fig. 3-8 Display Screen 6

In Fig. 3-8:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "A,B,C" represent A, B and C phase. The "N" is number 0-9; they are instantaneous active power of each phase.
- The "S" shall show " " for positive wattage, and "-" for negative wattage.

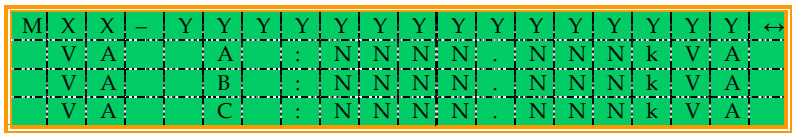


Fig. 3-9 Display Screen 7

In Fig. 3-9:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "A,B,C" represents A, B and C phase. The "N" is number 0-9; they are instantaneous apparent power of each phase.

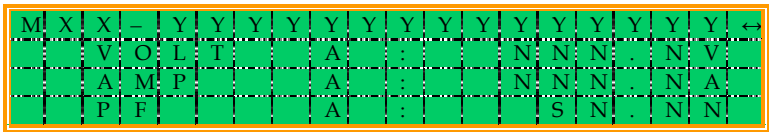


Fig. 3-10 Display Screen 8

In Fig. 3-10:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "N" is number 0-9; they are instantaneous voltage, current and power factor of A phase.
- The "S" is the sign of power factor. The negative PF is "Leading", and positive PF is "Lagging".

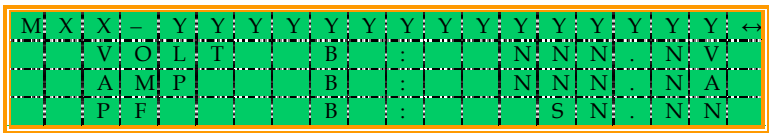


Fig. 3-11 Display Screen 9

In Fig. 3-11:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "N" is number 0-9; they are instantaneous voltage, current and power factor of B phase.
- The "S" is the sign of power factor. The negative PF is "Leading", and positive PF is "Lagging".

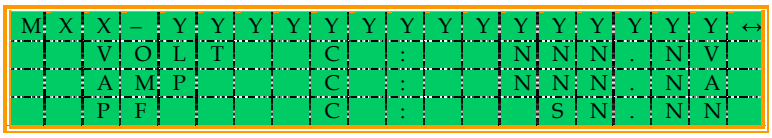


Fig. 3-12 Display Screen 10

In Fig. 3-12:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "N" is number 0-9; they are instantaneous voltage, current and power factor of C phase.
- The "S" is the sign of power factor. The negative PF is "Leading", and positive PF is "Lagging".

M	X	X	–	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	↔
A		T	H	D			V	–	N	N	N	%		I	–	N	N	N	%
B		T	H	D			V	–	N	N	N	%		I	–	N	N	N	%
C		T	H	D			V	–	N	N	N	%		I	–	N	N	N	%

Fig. 3-13 Display Screen 11

In Fig. 3-13:

- Where the "X" is the meter number, the "Y" is customer ID.
- The "↔" indicates the direction of energy flow (Delivered or Received energy). The "→" indicates delivered energy, and the "←" indicates received energy.
- The "N" is number 0-9; they are Total Harmonic Distortion (THD) voltage and current of each phase.

2. i-meter®45 Programming Software

i-meter®45 software V1.4 can be installed and run successfully in Windows XP and Windows 7. It is easy for you to create the configuration for programming and exporting CSV file. Excel 2007 or newer is recommended.

RUN "Setup.exe" to install the software.

2.1. Creating a configuration file

a. Run – C:\...\Intellimeter Canada Inc\imeter45, you shall see start window below,

Fig. 4-1 imeter45 Start Window

b. Click "New" in Fig. 4-1, you shall see the Phase Configuration Window (Fig. 4-2). You can configure the meter phasing according to your electrical panel. Click "Verify" to see if your configuration is correct. If it is not verified, you should check it again. Or click "Cancel" to cancel it. If is verified, click "Next" to save the configuration or program the meter.
Fig. 4-2 is a default 42 single phase meters and 1 three phase meter (main meter) configuration.

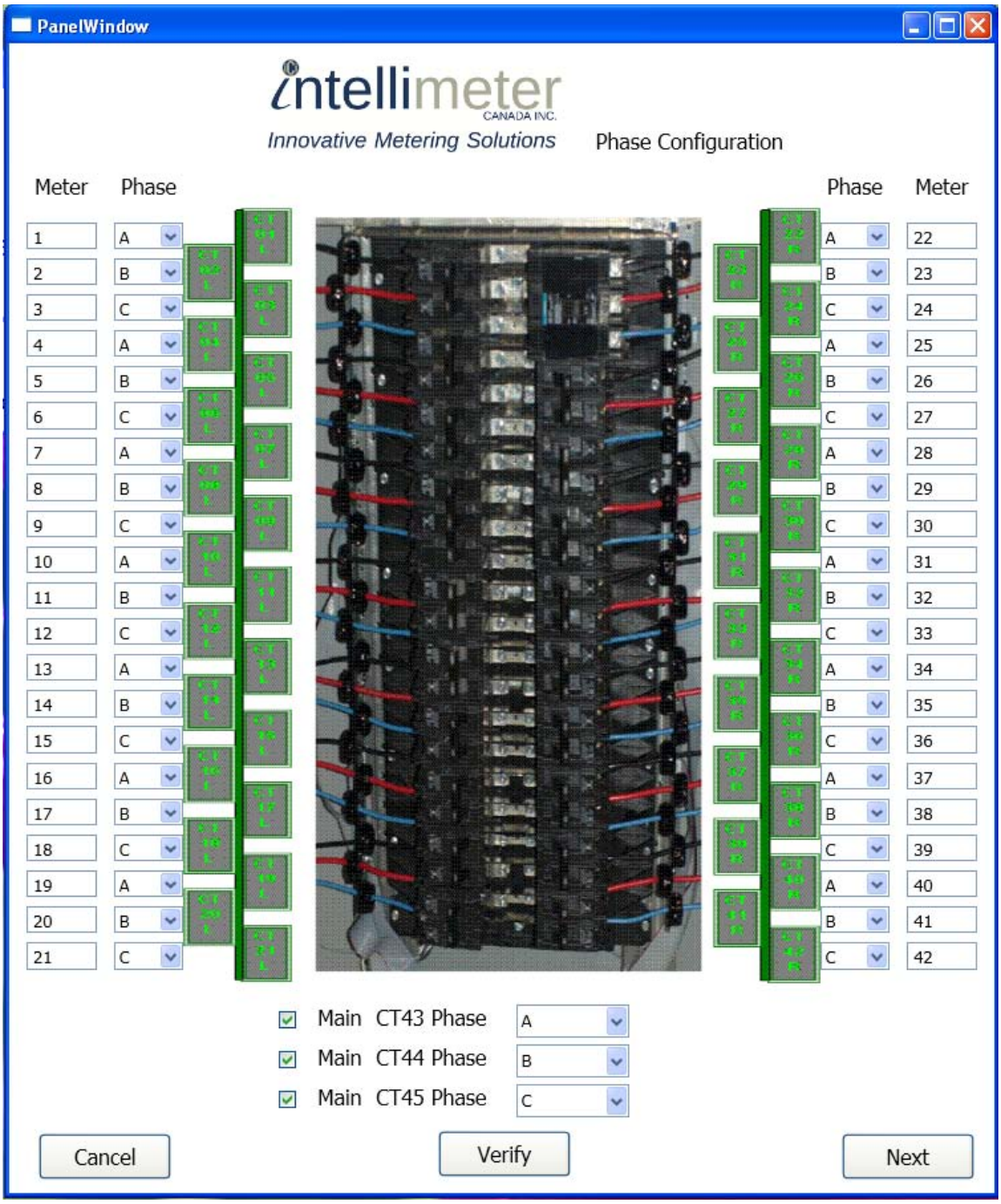


Fig. 4-2 i-meter®45 Phase Configuration Window

c. Click "Next" after the configuration has being verified, you shall see "Meter Detail Entry" window (Fig. 4-3).
You should be able to[1]:

- Program both the main meter and branch meter (Customer meter) CT ratio, meter constants[2] (1, 10 or 100);
- Program Customer Identification (max 15 characters);
- Program Customer Information (max 20 characters);
- Save the configuration file for future use.

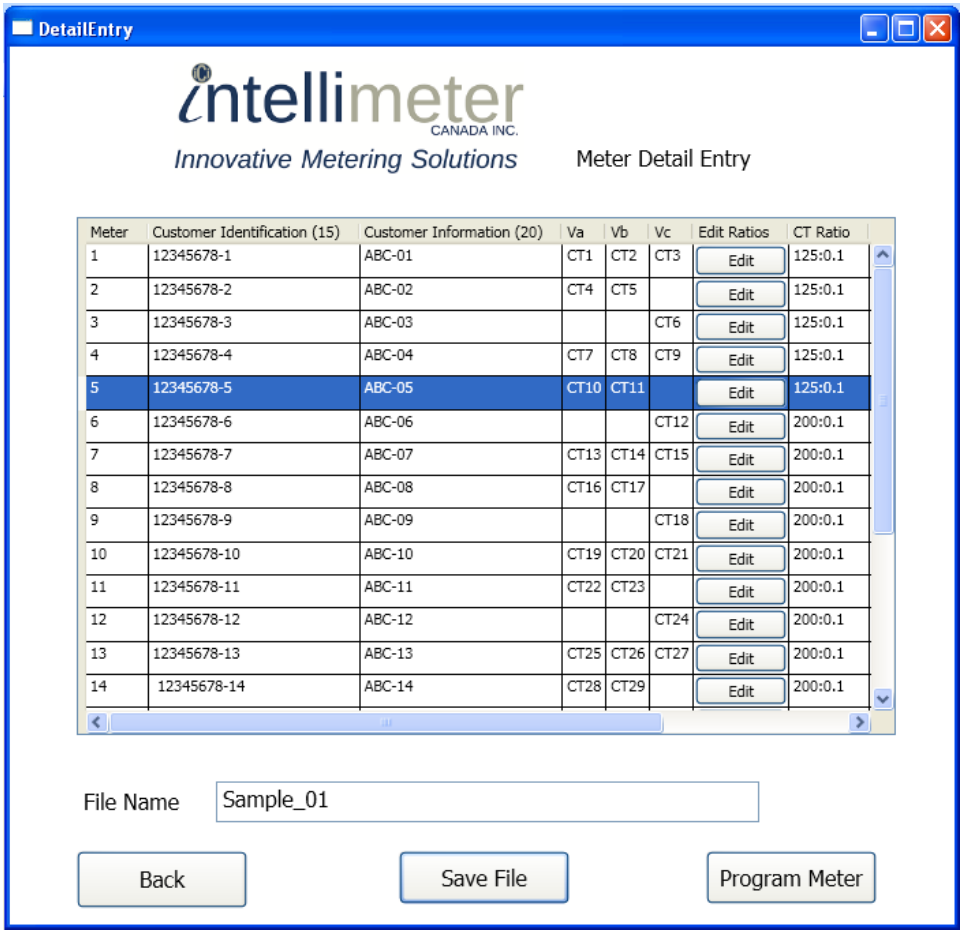


Fig. 4-3 i-meter®45 Meter Details Entry Window

[1] It is not necessary to enter every item below now. You can always do it later, at your convenience. However, the CT ratios must be programmed.

[2] You do not need to program VAh constants, which is the same value as Wh.

2.2. Programming meter configuration

a. Setup COM port – Click the "Setup", and then select proper COM port. Connect the meter "PRGM" port (J10) to the computer RS232 port[3] via a standard DB9 extension or ribbon cable.

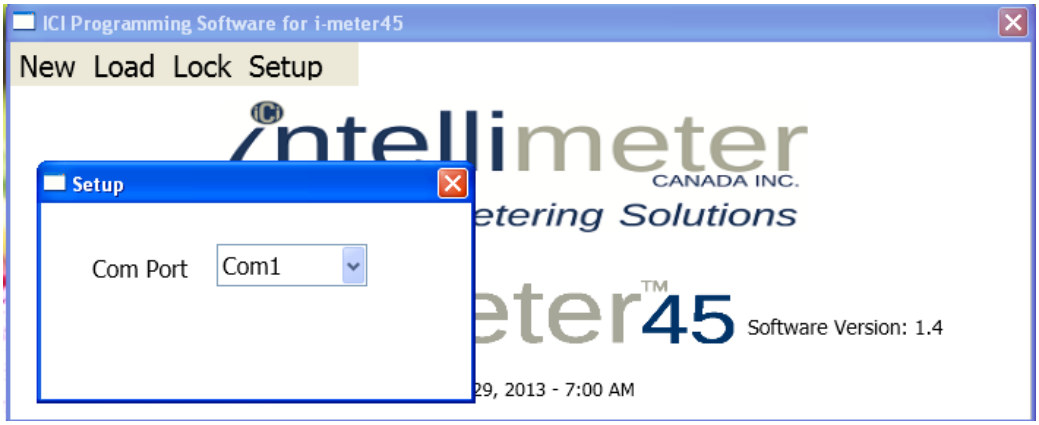
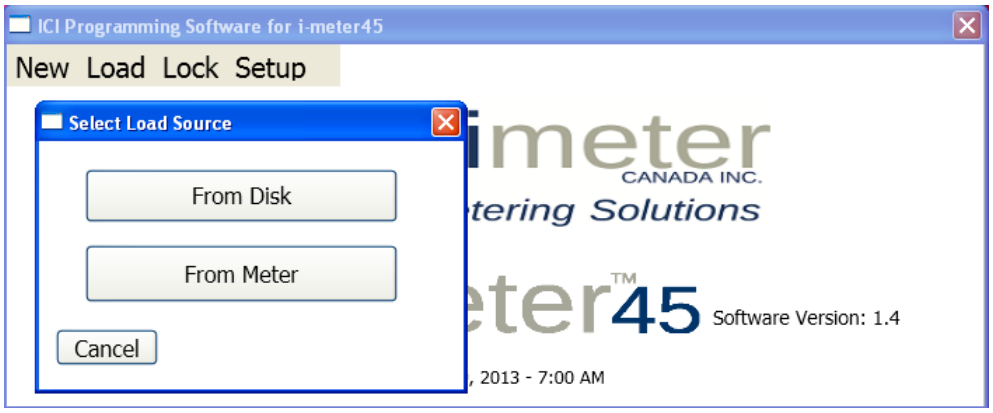


Fig. 4-4 Select COM port

b. Click the "Load" – You can select to load the configuration from disk or meter. And then, you can program the meter configuration. You are still able to modify the configuration if you would like to.



[3] You need a USB to RS232 serial adapter if you are using the USB port.

Fig. 4-5 Select Load Source

c. Click the "Program Meter" – The meter shall be programmed to the configuration you select if the meter is unlocked.

d. Electronic Sealing "Lock"– This feature is reserved for certain Sates or Countries that require extra security once programmed and verified. Contact ICI for assistance on this option.

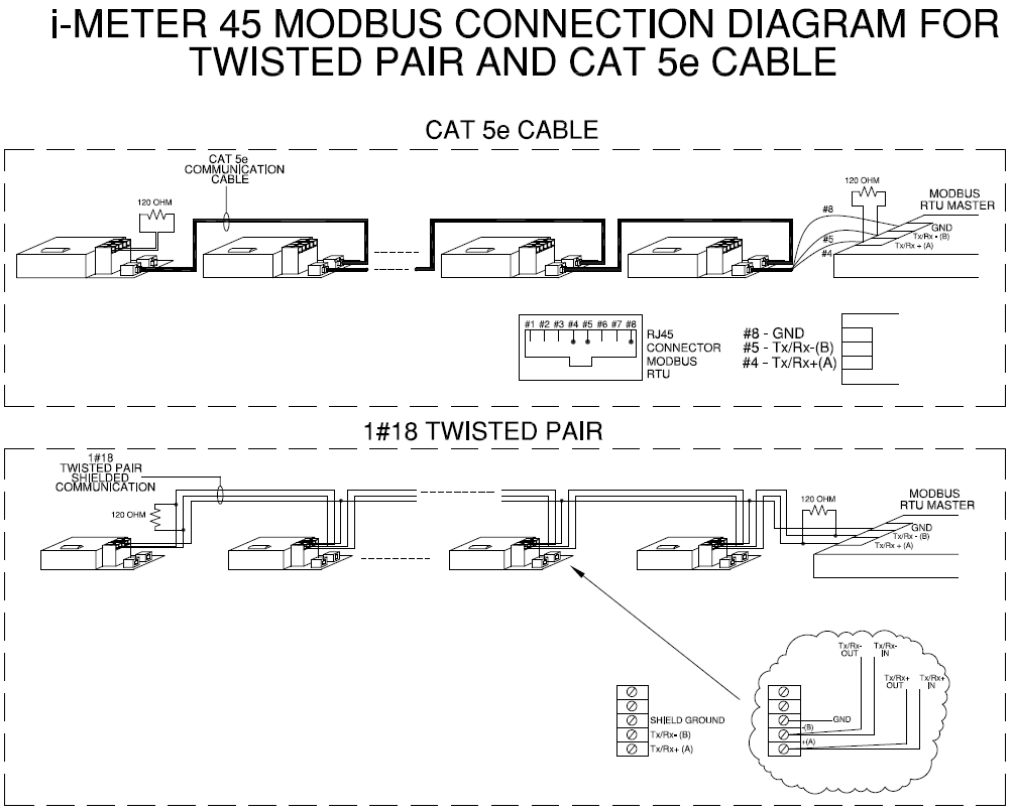
IMPORTANT NOTE: ONCE THE METER HAS BEING SEALED, YOU CANNOT PROGRAM ANY PARAMETER ANY MORE. THIS STEP SHOULD BE DONE ACCORDING TO SEALING PROCEDURE BY CERTIFIED TECHNICIAN.

i-meter45 ModBus Module

2.3. Introduction

The i-meter®45 ModBus module enables the meter to communicate on a ModBus system. It presents real time measurements, such as voltage, current, THD etc. The normal mode of the module supports RTU ModBus communication over an RS-485 network. Within 30 seconds of power up, the module will enter the normal mode of operation that supports ModBus communication. By default, the module communicates at 9600 bps, 8 data bits, no parity and 1 stop bit (8N1). The communication parameters and ModBus ID may be changed through the ModBus registers or through the Recovery Mode.

2.4.Electrical connection



2.5.Register Mapping

Table 5-1 Configuration Parameters

Modbus Address	Name	Format	Access	Default
40003	Firmware Version	UINT16		
41002	Address	UINT16	R/W	1
41003	Baud Rate	Enumated	R/W	3 = 9600 bps
Note	1. **Address - 41002**: Changes to the ModBus address takes effect immediately. The next command must use the changed address, otherwise the module will not respond. 2. **Baud Rate - 41003**: 3 = 9600 bps; 4 = 19200 bps; 5 = 38400 bps; 6 = 57600 bps; 7 = 115200 bps. The Baud Rate takes effect after power cycling.			

Table 5-2 Meter 0 Information

Modbus Address	Name	Format	Unit	Default
41100	Acitve Phases	Bit map	x1	
41101	Voltage A	UINT32	mV	
41103	Voltage B	UINT32	mV	
41105	Voltage C	UINT32	mV	
41107	Current A	UINT32	mA	
41109	Current B	UINT32	mA	
41111	Current C	UINT32	mA	
41113	Watts A	INT32	0.01 W	
41115	Watts B	INT32	0.01 W	
41117	Watts C	INT32	0.01 W	
41119	Volt-Amp A	INT32	0.01 VA	
41121	Volt-Amp B	INT32	0.01 VA	
41123	Volt-Amp C	INT32	0.01 VA	
41131	Power Factor A	INT32	0.001 Units	
41133	Power Factor B	INT32	0.001 Units	
41135	Power Factor C	INT32	0.001 Units	
41143	kWh	UINT32	Wh	
41145	kVAh	UINT32	VAh	
41149	Frequency	UINT32	0.01 Hz	
41155	Voltage Average	UINT32	mV	
41157	Meter Total Current	UINT32	mA	
41161	Meter Total Watts	UINT32	0.01 W	
41163	Meter Total VA	UINT32	0.01 VA	
Note	1. **Active Phases - 41100**: 0x0001 - Meter uses phase A; 0x0002 - Meter uses phase B; 0x0004 - Meter uses phase C. 2. **Voltage Average - 41155**: Average of the voltage from each phase. 3. **Meter Total Current - 41157**: Average of the current from each phase. 4. Meter 0 is assigned to the main meter if you program the configuration with main meter.			

Table 5-3 Meter x Information

Modbus Address	Name	Format	Unit	Default
4xx00	Acitve Phases	Bit map	x1	

4xx01	Voltage A	UINT32	mV	
4xx03	Voltage B	UINT32	mV	
4xx05	Voltage C	UINT32	mV	
4xx07	Current A	UINT32	mA	
4xx09	Current B	UINT32	mA	
4xx11	Current C	UINT32	mA	
4xx13	Watts A	INT32	0.01 W	
4xx15	Watts B	INT32	0.01 W	
4xx17	Watts C	INT32	0.01 W	
4xx19	Volt-Amp A	INT32	0.01 VA	
4xx21	Volt-Amp B	INT32	0.01 VA	
4xx23	Volt-Amp C	INT32	0.01 VA	
4xx31	Power Factor A	INT32	0.001 Units	
4xx33	Power Factor B	INT32	0.001 Units	
4xx35	Power Factor C	INT32	0.001 Units	
4xx43	kWh	UINT32	Wh	
4xx45	kVAh	UINT32	VAh	
4xx49	Frequency	UINT32	0.01 Hz	
4xx55	Voltage Average	UINT32	mV	
4xx57	Meter Total Current	UINT32	mA	
4xx61	Meter Total Watts	UINT32	0.01 W	
4xx63	Meter Total VA	UINT32	0.01 VA	
Note	1. The "xx" = 12+ n, where n = 0, 1 ... 44. For an example, meter 24 (n = 23), xx = (12+23) = 35, so the start address of meter 24 shall be 43500; 2. **Active Phases - 4xx00**: 0x0001 - Meter uses phase A; 0x0002 - Meter uses phase B; 0x0004 - Meter uses phase C. 3. **Voltage Average - 4xx55**: Average of the voltage from each phase. 4. **Meter Total Current - 4xx57**: Average of the current from each phase.			

Table 5-5 Harmonic Register Map

Modbus Address	Name	Format	Unit	Description/Format
47xxx	Meter	Enum		The meter that this element is associated with
47xxx+1	THD	UINT16	0.01%	Total harmonic distortion for this waverform
47xxx+2	Fundamental	UINT16	0.01%	Fundamental component for this waveform
47xxx+3	2nd Harmonic	UINT16	0.01%	2nd harmonic component for this waveform
47xxx+4	3rd Harmonic	UINT16	0.01%	3rd harmonic component for this waveform
47xxx+5	4th Harmonic	UINT16	0.01%	4th harmonic component for this waveform
47xxx+6	5th Harmonic	UINT16	0.01%	5th harmonic component for this waveform
47xxx+7	6th Harmonic	UINT16	0.01%	6th harmonic component for this waveform
47xxx+8	7th Harmonic	UINT16	0.01%	7th harmonic component for this waveform
47xxx+9	8th Harmonic	UINT16	0.01%	8th harmonic component for this waveform
47xxx+10	9th Harmonic	UINT16	0.01%	9th harmonic component for this waveform
47xxx+11	10th Harmonic	UINT16	0.01%	10th harmonic component for this waveform
47xxx+12	11th Harmonic	UINT16	0.01%	11th harmonic component for this waveform
47xxx+13	12th Harmonic	UINT16	0.01%	12th harmonic component for this waveform
47yyy	Meter	Enum		The meter that this element is associated with
47yyy+1	THD	UINT16	0.01%	Total harmonic distortion for this waverform
47yyy+2	Fundamental	UINT16	0.01%	Fundamental component for this waveform
47yyy+3	2nd Harmonic	UINT16	0.01%	2nd harmonic component for this waveform

47yyy+4	3rd Harmonic	UINT16	0.01%	3rd harmonic component for this waveform
47yyy+5	4th Harmonic	UINT16	0.01%	4th harmonic component for this waveform
47yyy+6	5th Harmonic	UINT16	0.01%	5th harmonic component for this waveform
47yyy+7	6th Harmonic	UINT16	0.01%	6th harmonic component for this waveform
47yyy+8	7th Harmonic	UINT16	0.01%	7th harmonic component for this waveform
47yyy+9	8th Harmonic	UINT16	0.01%	8th harmonic component for this waveform
47yyy+10	9th Harmonic	UINT16	0.01%	9th harmonic component for this waveform
47yyy+11	10th Harmonic	UINT16	0.01%	10th harmonic component for this waveform
47yyy+12	11th Harmonic	UINT16	0.01%	11th harmonic component for this waveform
47yyy+13	12th Harmonic	UINT16	0.01%	12th harmonic component for this waveform
Note	1. The "xxx" = 000, 010, ..., (000 + 10n), where (n+1) is the number of CTs or Current inputs, n = 0, 1, ..., 44. 2. The "yyy" = 460 (Voltage A), 480 (Voltage B), 500 (Voltage C),			

3. Appendix 1 -- Optional Pulse Output Board

	Any configurations with 23 to 43 meters (typical: 1ø Meter) Pulse outputs						Any configurations with 16 to 22 meters (Typical: 2ø Meter) Pulse outputs						Any configurations with 1 to 15 meters (Typical: 3ø Meter) Pulse outputs					
	LEDs			J15 - Pin No. (COM: Pin 49 & 50)			LEDs			J15 - Pin No. (COM: Pin 49 & 50)			LEDs			J15 - Pin No. (COM: Pin 49 & 50)		
Meter No.	Wh	VAh	varh	Wh	VAh	varh	Wh	VAh	varh	Wh	VAh	varh	Wh	VAh	varh	Wh	VAh	varh
main - 0	1	-	-	1	-	-	1	23	-	1	16	-	1	16	31	1	16	30
1	2	-	-	3	-	-	2	24	-	3	17	-	2	17	32	3	17	32
2	3	-	-	5	-	-	3	25	-	5	19	-	3	18	33	5	19	33
3	4	-	-	7	-	-	4	26	-	7	21	-	4	19	34	7	21	35
4	5	-	-	9	-	-	5	27	-	9	23	-	5	20	35	9	23	37
5	6	-	-	11	-	-	6	28	-	11	25	-	6	21	36	11	25	39
6	7	-	-	13	-	-	7	29	-	13	27	-	7	22	37	13	27	41
7	8	-	-	15	-	-	8	30	-	15	29	-	8	23	38	15	29	43
8	9	-	-	2	-	-	9	31	-	2	31	-	9	24	39	2	31	45
9	10	-	-	4	-	-	10	32	-	4	18	-	10	25	40	4	18	47
10	11	-	-	6	-	-	11	33	-	6	20	-	11	26	41	6	20	34
11	12	-	-	8	-	-	12	34	-	8	22	-	12	27	42	8	22	36
12	13	-	-	10	-	-	13	35	-	10	24	-	13	28	43	10	24	38
13	14	-	-	12	-	-	14	36	-	12	26	-	14	29	44	12	26	40
14	15	-	-	14	-	-	15	37	-	14	28	-	15	30	45	14	28	42
15	16	-	-	16	-	-	16	38	-	16	30	-						
16	17	-	-	17	-	-	17	39	-	18	32	-						
17	18	-	-	19	-	-	18	40	-	20	34	-						
18	19	-	-	21	-	-	19	41	-	22	36	-						
19	20	-	-	23	-	-	20	42	-	24	38	-						
20	21	-	-	25	-	-	21	43	-	26	40	-						
21	22	-	-	27	-	-	22	44	-	28	42	-						
22	23	-	-	29														
23	24	-	-	31														
24	25	-	-	18														
25	26	-	-	20														
26	27	-	-	22														
27	28	-	-	24														
28	29	-	-	26														
29	30	-	-	28														
30	31	-	-	30														
31	32	-	-	32														
32	33	-	-	33														
33	34	-	-	35														
34	35	-	-	37														
35	36	-	-	39														
36	37	-	-	41														
37	38	-	-	43														
38	39	-	-	45														
39	40	-	-	47														
40	41	-	-	34														
41	42	-	-	36														
42	43	-	-	38